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difficult circumstances. Some types are found clear up to the snow line which is here close to 19,000 ft. and only perpetual snow is able to stop plant growth. One thing that puzzled me for a long time was the increase of the number of species toward the top of the mountains and passes, instead of a decrease with the increased altitude. This is of course due to the larger amount of rain and snowfall on the summits.

I have not completed my catalog of the species I found in this alpine desert country, but I do not think that it will include more than four hundred forms including the cosmopolitan weeds. In a single valley in Kashmir one can find more types, and so I cannot recommend western Tibet to the hunter for new species. It is a place where the struggle is not between plant and plant, but between the plant world and a hostile environment, and one can examine plant adaptations to some very definite climatic conditions.

NEW SPECIES OF GRASS RUSTS

BY J. C. ARTHUR AND F. D. FROMME

In attempting properly to account for all collections in hand while working upon the manuscript for the next rust number of the *North American Flora*, the following forms are found to be sufficiently distinct to be entitled to specific recognition. They are mostly recent discoveries, but such forms as *P. Leptochloae* and *P. unica* have had an uncertain disposition for a number of years.

***Uromyces Jacksonii* sp. nov.**

II. Uredinia amphigenous and cauliculous, scattered, bullate, oblong or linear, 0.3–1 mm. long, tardily opening by slit in the epidermis, yellow; paraphyses none; urediniospores globoid, 21–26 by 24–30 μ ; wall pale yellow, moderately thin, 1.5–2 μ , finely echinulate, the pores 6–8, scattered.

III. Telia similar to the uredinia, long covered by the epidermis, blackish-brown; teliospores angularly globoid or ellipsoid, 19–25 by 20–30 μ ; wall light chestnut-brown, uniformly 1.5 μ thick, smooth; pedicel colorless, about half length of spore, delicate.

On *Deschampsia elongata* (Hook.) Munro, Orenco, Ore., June 13, 1396, Corvallis, Ore., July 6, 2658 (type), Glendale, Ore., Aug. 17, 1408, all in 1914 by H. S. Jackson, and Bremerton, Wash., July 20, 1912, E. Bartholomew 4755 (Barth., N. Am. Ured. 1237, and Fungi Columb. 4460); on *Agrostis Hallii* Vasey, Corvallis, Ore., Sept. 4, 1914, H. S. Jackson 1576. Only the type collection and the one on *Agrostis* show telia in addition to the uredinia. When only the uredinia were known this rust was mistaken for *Puccinia Deschampsiae* Arth., from which it differs notably by the absence of uredinial paraphyses. It somewhat resembles *Uromyces Hordei* Tracy, but may be distinguished by the absence of uneven thickening in the teliosporic wall. The species is dedicated to Professor H. S. Jackson, of the Oregon Agricultural College, whose ability as a collector and keen botanical insight have added greatly to the knowledge of Oregon rusts as well as of other departments of the local botany.

***Uromyces Archerianus* sp. nov.**

II. Uredinia not seen; urediniospores from telial sori globoid or broadly ellipsoid, 19–23 by 21–26 μ ; wall golden- to cinnamon-brown, moderately thick, 2–3 μ , finely and inconspicuously verrucose, the pores usually obscure, 2, equatorial.

III. Telia hypophyllous, prominent, oblong or linear, 0.5–10 or more mm. long, early naked, pulvinate, blackish-brown; teliospores globoid to broadly ellipsoid, 18–26 by 25–32 μ , rounded above and below; wall dark chestnut-brown, 1.5–2 μ thick, becoming considerably thicker above, 7–9 μ , smooth; pedicel yellowish or colorless, firm, 3–4 μ thick, once to twice length of spore.

On *Chloris elegans* H.B.K., Mesilla Park, N. Mex., November 12, 1914 (type), February 7 and March 22, 1915, W. A. Archer. In gross appearance and in microscopic characters as well, this rust somewhat resembles *Puccinia subnitens* and *Uromyces Peckianus*, both on *Distichlis*. The teliospores of the new species are considerably shorter, often quite globoid, and less inclined to be narrowed below; the urediniospores are generally slightly larger and thicker walled. The most distinctive morphological character is in the uredinial pores, which are two and equatorial, contrasting sharply with the six scattered pores of the other

species. The resemblance here indicated led to the sowing of telial material supplied by Mr. Archer upon *Chenopodium album*, aecial host for both *U. Peckianus* and *P. subnitens*. Sowings were made on April 15, from both the November and February collections, but without result. The species is in many ways quite unlike *Puccinia Chloridis* Speg., which occurs in the northern part of New Mexico, and elsewhere, the latter having colorless urediniospores with apical thickening.

All the material and observations for this species were supplied by Mr. W. A. Archer, a freshman student of the New Mexico Agricultural College, now in his sophomore year, who accompanied the authors on a trip to the Organ mountains in March, 1914, and has since done effective service in making known the rust flora of southern New Mexico. The specific name is given in recognition of Mr. Archer's scientific acumen.

***Puccinia dolosa* sp. nov.**

II. Uredinia amphigenous, evenly distributed, small, early naked, cinnamon-brown; paraphyses none; urediniospores angularly globoid to obovoid, 16–21 by 19–24 μ ; wall golden- or cinnamon-brown, 1–1.5 μ , echinulate, the pores 3, equatorial.

III. Telia amphigenous, small, tardily naked, dark chestnut-brown; teliospores broadly ellipsoid, often irregular, 19–26 by 30–42 μ , rounded at both ends, slightly constricted at septum; wall smooth, cinnamon- or chestnut-brown, 1–1.5 μ , slightly thickened at apex, 3–4 μ ; pedicel fragile, short, slightly tinted or colorless.

On *Paspalum tenellum* Willd., Guadalajara, Mex., Sept. 25, 1903, E. W. D. Holway (Sydow, Ured. 1986), City of Mexico, Mex., Oct. 11, 1898, E. W. D. Holway 3065; on *P. paniculatum* L., Cuernavaca, Mex., Sept. 28, 1899, E. W. D. Holway 3514, Sept. 10–11, 1910, A. S. Hitchcock. The first named collection is taken as the type. The species has heretofore been included with *Puccinia substriata*, from which it differs in the smaller uredinia, and urediniospores. The urediniospores are also paler, thinner-walled, and with the pores uniformly three so far as observed. It appears to be a species confined to central Mexico, while *P. substriata* is a semitropical species extending around the world.

***Puccinia Leptochloae* sp. nov.**

II. Uredinia amphigenous, oval or oblong; urediniospores globoid, 21–24 by 23–26 μ ; paraphyses none; wall light cinnamon-brown, moderately thick, 2–2.5 μ , minutely and closely verrucose, the pores usually 4, sometimes 6, scattered.

III. Telia amphigenous, crowded, oval to linear, 0.5–2 mm. long, early naked, blackish-brown; teliospores oblong or broadly ellipsoid, 21–27 by 26–35 μ , rounded at both ends, slightly constricted at septum; wall dark chestnut-brown, 2 μ thick, considerably thicker above, 3–7 μ ; pedicel golden, once length of spore.

On *Leptochloa filiformis* (Lam.) Beauv. (*L. mucronata pulchella* Scribn.), Guaymas, Mex., 1887, Dr. Edward Palmer 694. The species was detected by Dr. P. L. Ricker on a phanerogamic specimen in the National Herbarium some years ago. This host collection is cited in Hitchcock's Mexican grasses (Contr. Nat. Herb. 17: 349. 1913). Only the type collection is yet known, although the host has an extended range from Virginia to the Pacific coast and southward into South America, including the West Indies.

The species has some resemblance to *Puccinia Jamesiana* Arth., which occurs on *Leptochloa dubia* in central Mexico, but differs in having the urediniospores verrucose instead of echinulate, and with much thicker walls, as well as in other particulars.

***Puccinia unica* Holway sp. nov.**

II. Uredinia not seen; urediniospores intermixed with the teliospores, ellipsoid, 19–24 by 24–29 μ ; wall cinnamon-brown, 1.5–2 μ thick, inconspicuously echinulate, the pores 4 or 5, approximately equatorial; paraphyses numerous, intermixed, capitate, 13–18 μ broad above, up to 60 μ long, the wall about 7 μ thick above, becoming 2 μ thick in the pedicel which is often solid.

III. Telia caulicolous and epiphyllous, crowded and often confluent in lines, elliptical or oblong-linear, 0.5–2 mm. long, early naked, pulvinate, blackish-brown; teliospores ellipsoid, 21–26 by 29–39 μ , rounded at both ends, slightly or not constricted at septum; wall dark chestnut-brown, smooth, 2–3 μ thick, slightly thicker above, 3–6 μ ; pedicel twice length of spore or more.

On *Aristida longiramea* Presl, Cuernavaca, Mexico, Sept. 27, 1898, E. W. D. Holway 3020. This collection was early recognized by Professor Holway as doubtless representing an undescribed species. As no comprehensive survey of the American grass rusts had then been made, the publication of the proposed name was withheld. The gross appearance of this rust in its prominent, blackish sori is not unlike that of *Puccinia graminis* Pers. and *P. Aristidae* Tracy, and in the microscopic appearance of both urediniospores and teliospores there is also much resemblance. The numerous capitate paraphyses, however, when coupled with the other characters, easily and strongly separate the species. The host is cited in Hitchcock's Mexican grasses (Contr. Nat. Herb. 17: 279. 1913) from a phanerogamic specimen with same data, deposited at Washington.

***Puccinia Chaseana* sp. nov.**

II. Uredinia amphigenous, numerous, scattered, oval, 0.3–0.5 mm. long, early naked, cinnamon-brown; paraphyses peripheral, numerous, incurved, cylindric, hyphoid, 5–9 by 30–35 μ , the wall uniformly thin, 1 μ , colorless; urediniospores globose or broadly ellipsoid, 22–28 by 24–30 μ ; wall cinnamon-brown, moderately thin, 1.5–2 μ , closely and finely echinulate, the pores 4, equatorial.

III. Telia amphigenous, inconspicuous, few, long covered by the epidermis; teliospores obovoid or obovoid-clavate, 19–26 by 38–45 μ , truncate or rounded above, somewhat narrowed below, slightly or not constricted at septum; wall cinnamon- to chestnut-brown, darker above, 1–1.5 μ thick, thicker above, 5–7 μ ; pedicel tinted, short.

On *Antheophora hermaphrodita* (L.) Kuntze, Jamaica, Lloyd 1118 (type); Spot Bay, Grand Cayman, C. F. Millspaugh 1269. For the material here cited we are indebted to the kindness of Mrs. Agnes Chase, assistant agrostologist in the U. S. Department of Agriculture, who examined the specimens of *Antheophora* in the National Herbarium and was able to detect evidences of rusts on the two collections cited. This examination was undertaken at the suggestion of the senior author in order to obtain material for study of *Uredo Antheophorae* Sydow, described in 1903 (Ann. Myc. 1: 22) from a Cuban collection. This form was

later found in Hope Gardens, Jamaica, by Eug. Mayor, and verified by him (Mem. Soc. Neuch. Sc. Nat. 5: 577. 1913). Material representing this species of *Uredo* does not yet occur in any American collection. Greatly to my surprise the two West Indian collections detected by Mrs. Chase, one being from Jamaica where Mayor made his collection, are wholly unlike the species described by Sydow, and in fact appear to represent one that is undescribed and very distinctive. We take pleasure in naming this new species in honor of Mrs. Chase as a slight recognition of her devotion to botanical investigations, her eminent services to agrostology, and her disinterested assistance freely given to workers in other lines of research. The species appears to be most closely related to *Puccinia polysora* Underw., on *Tripsacum*, which has larger urediniospores, however, with five instead of four pores, and has not yet been found in the West Indies. The description of *Uredo Anthephorae* given by Sydow and Mayor, if one may venture a guess, indicates that the form may belong to *Puccinia Cenchri* Diet. & Holw., which occurs in the West Indies on *Cenchrus*, but is not reported on *Anthephora*.

***Uredo quinqueporula* sp. nov.**

II. Uredinia amphigenous, scattered, few, elliptical to oblong-linear, 0.5–2.5 mm. long, early naked, chestnut-brown; paraphyses none; urediniospores ellipsoid or oblong-ellipsoid, 19–24 by 25–33 μ ; wall moderately thick, 1.5–2.5 μ , golden- to cinnamon-brown, echinulate, the pores 5, sometimes 4, equatorial.

On *Torresia macrophylla* (Thurb.) Hitchc. (*Savastana macrophylla* Beal, *Hierochloa macrophylla* Thurb.), Glendale, Oregon, July 17, 1914, H. S. Jackson 1411. This non-paraphysate grass rust is especially noteworthy in having the larger part of its urediniospores equatorially five-pored.

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SHORTER NOTES

EQUISETUM IN THE FLORISSANT MIOCENE. During years of collecting from the Miocene shales at Florissant, Colorado, we failed to find any material of *Equisetum*, although it could hardly